inverse quantizing the image data blocks to generate quantized data blocks;

performing an inverse transformation on the quantized data blocks to generate transformed data blocks;

obtaining original image data from at least one of the transformed data blocks.

performing motion compensation processing for said transformed data blocks;

A3 cancel.

Remarks

Claims 1-19 are pending in this application and have been amended as shown in Appendix B. Claims 1-9 stand rejected under §102(e) as anticipated by Kato (U.S. Pat. No. 6,167,087). Claims 10-19 stand rejected under §103(a) as unpatentable over Kato in view of Takahashi (U.S. Pat. No. 6,005,623). The Applicants respectfully traverse these rejections.

Independent claims 1 and 7 are directed to an apparatus and method, respectively, for encoding image data (e.g., according to the MPEG-2 standard). Similarly, independent claims 10 and 17 are directed to an apparatus and method, respectively, for decoding image data (e.g., MPEG-2 coded data). The independent claims share in common that the coding and decoding operations are performed in parallel on multiple processors.

For example, claim 1 recites that the encoding apparatus comprises a multiprocessor system in which individual signal processing devices perform both fixed length and variable length coding. In particular, as claimed, the signal processing devices include a master processor and a slave processor for executing in parallel the fixed length coding and the variable length coding. (Specification, pages 22-26 35-41,

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Figures 12, 18). Claim 10 recites parallel limitations for the decoding apparatus. (Specification, pages 2-35, 42-48, Figures 15, 21).

In a manner similar to that of claims 1 and 10, the independent method claims recite processing in parallel on multiple processors. For example, claim 7 recites allotting data blocks to individually assigned signal processing devices, and, in parallel, encoding the data blocks. Claim 17 recites parallel limitations for the decoding method.

Turning to the rejections, Kato discloses a picture signal encoding method and apparatus. In particular, in Figure 9, Kato illustrates a picture encoding device including a motion detector circuit 201, bitrate controller 204, and an encoding circuit 105. Kato, however, does not set forth the parallel processing techniques presently claimed. Rather, Kato focuses on providing a relative coding difficulty measure that works in conjunction with the bitrate controller.

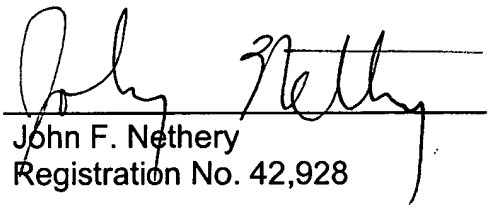
Takahashi is directed to an image conversion apparatus. Takahashi, however, does not teach or suggest that data blocks may be encoded or decoded in parallel as claimed. Instead, Takahashi focuses on converting compressed image data of a first type into compressed image data of a second type. Thus, even assuming motivation to combine Takahashi and Kato, such a combination would not teach or suggest the claimed subject matter.

Conclusion

For the forgoing reasons, the Applicant requests withdrawal of the pending rejections. Should anything remain in order to place the present application in condition

for allowance, the Examiner is kindly invited to contact the undersigned at the telephone number listed below.

Respectfully submitted,



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APPENDIX A
VERSION WITH MARKINGS TO SHOW CHANGES MADE IN SPECIFICATION

The paragraph starting on page 1, line 7, is modified as follows:

The present invention relates to an encoding apparatus for transforming data such as video data and audio data, for example, the MPEG method (high quality moving picture encoding system by Moving Picture Coding Experts Group), to a bit stream composed of variable length data, and to a decoding apparatus of the same, and more particularly relates to an encoding apparatus and a decoding apparatus for carrying out encoding and decoding at a high speed by parallel processing and methods of the same.

The paragraph starting on page 26, line 20, is modified as follows:

Note that the variable length coding can be divided into the phase for generating the variable length data from the fixed length data by table conversion and the phase for combining the variable length data to generate the bit stream. These two phases may be sequentially executed, or only the latter phase may be [sequently] sequentially executed and the former phase be executed in parallel. Note that a buffer memory becomes necessary between the former phase and the latter phase in the latter method.

APPENDIX B
VERSION WITH MARKINGS TO SHOW CHANGES MADE IN CLAIMS

1. (Amended) An encoding apparatus for encoding a data stream comprising a plurality of data blocks [which comprises a plurality of block data including a plurality of element data which are sequentially transferred in a form of a data stream,] the encoding apparatus comprising a multiprocessor system comprising:

a plurality of signal processing devices connected by a signal transfer means on which said data blocks are [is] transferred, each signal processing device comprising:

an fixed length encoding means for [encoding a] carrying out a fixed length coding of selected data blocks [block data including a plurality of element data on the signal transfer means] to produce encoded data blocks; and

a variable length coding means for carrying out a variable length coding of said encoded data blocks [block data] and outputting [the] variable length coded data blocks via said signal transfer means [in accordance with the data stream.]; and wherein

said plurality of signal processing devices includes a master processor and a slave processor for executing in parallel the fixed length coding and the variable length coding.

2. (Amended) An encoding apparatus as set forth in claim 1, wherein each of said variable length coding means of said plurality of signal processing devices detects completion of the variable length coding of a current data block and starts variable length coding of a subsequent data block. [when the encoded data of the previous block data in said data stream has been subjected to variable length coding for the encoded data of the current block data encoded in the signal processing device and starts the

variable length coding for the current encoded data after the substantial end of that variable length coding.]

3. (Amended) An encoding apparatus as set forth in claim 2, wherein:

said data stream [is] comprises image data,

each of said fixed length encoding means of said plurality of signal processing devices carries out said fixed length encoding for each image slice data block comprising an image slice [every block image data of a predetermined plurality of block image data obtained by dividing said image data], and

each of said variable length coding means of said plurality of signal processing devices carries out variable length coding on each image slice data block. [the encoded data for every said block image data in a predetermined order based on the arrangement of the block image data on said image data].

4. (Amended) An encoding apparatus as set forth in claim 3, wherein

each of said fixed length encoding means of said plurality of signal processing devices comprises;

a motion compensation predicting means for selectively carrying out motion compensation prediction by referring to a reference image [for every predetermined block image data of said image data],

a transform means for carrying out a predetermined transform with respect to pixel data of a result of said motion compensation prediction or with respect to original pixel data to provide transformed block data,

a quantizing means for quantizing the transformed block data to provide quantized block data [for every said block image data subjected to said transform], and

a local decoding means for decoding the transformed block data [for every said quantized block image data] to generate the reference image to be supplied to said motion compensation predicting means, and wherein

each of said variable length coding means of said plurality of signal processing devices carries out variable length coding on the quantized block data [for every said quantized block image data].

5. (Amended) An encoding apparatus as set forth in claim 4, wherein said data blocks are macroblocks [block image data is the image data for every macroblock].

6. (Amended) An encoding apparatus as set forth in claim 4, wherein the predetermined transform is [said transform means of each of said encoding means carries out processing including an orthogonal transform including] any of a discrete cosine transform (DCT), a Fourier transform, a Hadamard transform, and a K-L transform.

7. (Amended) An encoding method for encoding a data stream [having a plurality of element data], the method comprising [the steps of]:

dividing said data stream into a [predetermined] plurality of [block data] data blocks;

successively allotting said [divided plurality of block data to] data blocks to individually assigned signal processing devices in a plurality of signal processing devices;

encoding said data blocks [allotted block data based on a predetermined method] in parallel in each of said [plurality of] individually assigned signal processing devices to produce encoded data blocks;

successively carrying out variable length coding on the encoded data blocks in its individually assigned signal processing device [in the same signal processing devices as those for the encoding so that the encoded data for every said block data encoded in said plurality of signal processing devices are successively subjected to the variable length coding according to the order in said data stream]; and

successively allotting [new block data] additional data blocks to the signal processing devices [for which said variable length coding is ended] that have completed variable length coding.

8. (Amended) An encoding method as set forth in claim 7, wherein each of said plurality of signal processing devices detects when variable length coding for a current data block has been completed and begins variable length coding of a subsequent data block. [the encoded data of the previous block data in said data stream has been subjected to variable length coding for the encoded data of the current block data encoded at that signal processing device and starts the variable length coding of the current encoded data after that variable length coding has substantially ended.]

9. (Amended) An encoding method as set forth in claim 8, wherein

said data stream [is] comprises image data,

[said image data is divided into a predetermined plurality of block image data,

said divided plurality of block image data are successively allotted to a plurality of signal processing devices,]

and further comprising the steps of, in each of said plurality of signal processing devices,

performing motion compensation prediction for said data blocks by referring to a reference image to generate compensated data blocks;

performing a predetermined transformation on the compensated data blocks to generate transformed data blocks;

quantizing the transformed data blocks to generate quantized data blocks; and

obtaining the reference image from at least one of the quantized data blocks.

[motion compensation prediction is selectively carried out for every said allotted block image data by referring to a reference image,

a predetermined transform is carried out with respect to the block image data of the result of said motion compensation prediction or original block image data,

the data for every said block image data subjected to said transform is quantized,

the end of the variable length coding with respect to the previous block image data in said image data for the current block image data is detected,

said quantized data are subjected to the variable length coding after the variable length coding with respect to said previous block image data is substantially ended to generate the block image data subjected to the variable length coding,

said quantized block image data are decoded to generate the reference image to be supplied to said motion compensation prediction

new block image data is successively allotted with respect to said signal processing devices for which said variable length coding has ended.]

10. (Amended) A decoding apparatus for decoding a data stream comprising a plurality of data blocks including fixed and variable length coded data blocks [encoded and variable length coded data which comprises a plurality of block data including a plurality of element data in a form a data stream], the decoding apparatus comprising:

a multiprocessor system comprising a plurality of signal processing devices, each of the signal processing devices comprising:

a variable length decoding means for successively carrying out variable length decoding on variable length coded data blocks [block data in accordance with the data stream] to obtain fixed length encoded data blocks; and

a fixed length decoding means for fixed length decoding said fixed length encoded data blocks [variable length decoded block data.], wherein

said plurality of signal processing devices includes a master processor and a slave processor for executing in parallel the fixed length decoding and the variable length decoding.

11. (Amended) A decoding apparatus as set forth in claim 10, wherein each of said variable length decoding means of said plurality of signal processing devices detects completion of the variable length coding of a current data block and starts variable length coding of a subsequent data block. [a timing of which the variable length coded

data of the previous block data in said data stream has been subjected to the variable length decoding for the variable length coded data for the current block data and starts the variable length decoding of the current variable length coded data after the previous variable length decoding has substantially ended].

12. (Amended) A decoding apparatus as set forth in claim 11, further comprising an allotting means for sequentially allotting the variable length coded data blocks [for every said block data of said encoded data stream] to said plurality of signal processing devices, and

wherein each of the signal processing devices performs both the variable length decoding and the fixed length decoding of a data block allotted to it.

[wherein each of said variable length decoding means of said plurality of signal processing devices starts the variable length decoding processing at said timing for the variable length coded data for every said block data allotted by said allotting means,

wherein each of said decoding means of said plurality of signal processing devices subsequently carries out the decoding of the related variable length decoded data after the end of the variable length decoding of the variable length coded data for every block data in said variable length decoding means of the same signal processing device, and

wherein said allotting means allots variable length coded data for every new block data to the signal processing devices for which said decoding is ended.]

13. (Amended) A decoding apparatus as set forth in claim 11, wherein

said [encoded] data stream is a variable length coded image data stream obtained by fixed length and variable length encoding of image data blocks and wherein each of the signal processing devices performs both the variable length decoding and the fixed length decoding of a data block allotted to it.

[encoding image data for every predetermined block image data and further carrying out variable length coding,

each of the variable length decoding means of said plurality of signal processing devices successively carries out variable length decoding on the variable length coded image data for every allotted block image data, and

each of the decoding means of said plurality of signal processing devices decodes the encoded image data for every said block image data subjected to the variable length decoding in said variable length decoding means of the same signal processing device.]

14. (Amended) A decoding apparatus as set forth in claim 13, wherein

each of decoding means of said plurality of signal processing devices comprises

an inverse quantizing means for inverse quantizing variable length decoded data blocks to obtain inverse quantized data blocks. [the encoded image data for every block image data obtained by variable length decoding of said variable length coded image data],

an inverse transform means for carrying out an inverse transform [for the predetermined transform with respect to said inverse quantized data] on said inverse quantized data blocks to obtain inverse transformed data blocks,

an image data generating means for generating [the] original image data by referring to [the] a reference image [according to need based on the data for every said block image data subjected to said inverse transform], and

a motion compensation processing means for carrying out motion compensation processing based on at least one of the inverse transformed data blocks and said image data blocks to generate said reference image [the data for every said block image data subjected to said inverse transform or said original block image data generated according to need to generate said reference image].

15. (Amended) A decoding apparatus as set forth in claim 14, wherein said image data blocks are macroblocks [block image data is the image data for every macroblock].

16. (Amended) A decoding apparatus as set forth in claim 14, wherein said inverse transform [means of each of said plurality of decoding means carries out the inverse transform of the orthogonal transform including any] is one of a discrete cosine transform (DCT), Fourier transform, Hadamard transform, and K-L transform.

17. (Amended) A decoding method for decoding a data stream comprising a plurality of data blocks including fixed and variable length coded data blocks, the method comprising: [variable length coded data stream obtained by encoding a data

stream having a plurality of element data for every predetermined block data and further carrying out variable length coding, comprising the steps of:]

successively allotting variable length coded data blocks to a plurality of signal processing devices; [the variable length coded data for every said block data successively arranged in said variable length coded data stream to a plurality of signal processing devices;]

in each signal processing device, carrying out both variable length decoding on an assigned data block followed by fixed length decoding of said assigned data block,

wherein the signal processing devices perform the variable length decoding and fixed length decoding of assigned data blocks in parallel.

[successively carrying out variable length decoding on the variable length coded data for every allotted block data so that the variable length decoding carried out in the plurality of signal processing devices is successively carried out according to the order of said block data in said data stream in each of said plurality of signal processing devices;

decoding the encoded data for every said block image data subjected to said variable length decoding in the same signal processing device in each of said plurality of signal processing devices; and

allotting variable length coded data of new block data to be decoded next to said signal processing devices for which said decoding is ended.]

18. (Amended) A decoding method as set forth in claim 17, wherein each of said plurality of signal processing devices detects when variable length decoding for a

current data block has been completed and begins variable length decoding of a subsequent data block. [when the variable length coded data of the previous block data in said data stream has been subjected to variable length decoding for the variable length coded data for every allotted block data and starts the variable length decoding of that variable length coded data after that variable length decoding is substantially ended.]

19. (Amended) A decoding method as set forth in claim 18, wherein

said [variable length coded] data stream comprises a plurality of image data blocks, [is variable length coded image data obtained by encoding image data for every predetermined block image data and further carrying out variable length coding,]

[the variable length coded image data for every block image data successively arranged in said variable length coded image data is successively allotted to a plurality of signal processing devices,]

and further comprising the steps of, in each of said plurality of signal processing devices,

inverse quantizing the image data blocks to generate quantized data blocks;

performing an inverse transformation on the quantized data blocks to generate transformed data blocks;

obtaining original image data from at least one of the transformed data blocks,

performing motion compensation processing for said transformed data blocks;

[the variable length coded image data for every allotted block image data is subjected to variable length decoding,

the encoded image data for every variable length decoded block image data is inversely quantized,

the inverse transform of the predetermined transform is carried out with respect to said inversely quantized data,

the original block image data is generated by referring to a reference image according to need based on the data for every block image data for which said inverse transform was carried out, and

motion compensation processing is carried out based on the data for every said block image data for which said inverse transform was carried out or said data generated according to need to generate said reference image.]

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